Abstract: The article presents the results of the analysis carried out under the Environmental Study for Local Development Policy of Kielce. The main goal of the analysis was to identify the primary conditions which should be taken into consideration when preserving the visual values in urban planning. The analysis was focused on identification and description of the existing features within landscape (including their transformation) and on its ability to accommodate changes. The first step of the survey was focused on identification of changes in the townscape character, taking into account: extent of the urban fabric, character of the built-up areas and their origin. The analysis of changes in the townscape was based on archival cartographic materials. To determine the cultural stratigraphy of the town a three-time scale was used: areas formed before the middle of the twentieth century, areas created in the 3rd quarter of the twentieth century and areas created in the 4th quarter of the twentieth century and at the beginning of the twenty-first century. Analysis of changes in the landscape consisted mainly of changes in the land use structure, as well as the analysis of layout of individual elements forming the urban landscape (e.g. landmarks). The second part of the study was related to examining the visual exposure of identified townscape character areas. The exposure analysis was based on views from the scenic viewpoints as well as a sequence of points located along major transit roads and hiking trails. Totally more than 100 viewpoints were analyzed. This analysis aimed at presenting areas particularly exposed in the townscape. On the basis of townscape changes and visual exposure the authors of the study assessed the state of landscape values preservation and the visual absorption capacity. This assessment was a starting point to work out guidelines for future development. Special attention was paid to areas important for preservation of landscape exposition of objects of special cultural values (1) and areas dedicated to urban development with low visual absorption capacity (2). Recommendations for spatial development comprise: restrictions on location of high construction works as well as woodlands and other high vegetation (1), the need for adapting new buildings to the surrounding landscape and to the form and dimensions of existing objects (2). Identifications and assessment of the visual aspects as well as changes in the landscape became, together with the conditions resulting from the state and functioning of the environment, one of the major determinants for shaping the spatial structure of the city.

Key words: visual analysis, visual expose, townscape

Introduction

This article presents the results of the analyses carried out under the Environmental study which was performed for the needs of the Municipal study of spatial development conditions and directions for Kielce in the years 2008-2009. The environmental study was carried out in accordance with the requirements specified in art. 72, the Act of 27 April 2001 - Environmental Protection Law. However, due to the fact that in case of a municipal study of spatial
development conditions and directions regulations issued by the Ministry of the Environment of 9 September 2002 on environmental studies are not binding, the problem scope was specified on the basis of problem analysis and scale of solutions typical of spatial and functional structure formation of a large city.

The environmental study carried out for Kielce consists of three major parts:

- analytical, encompassing characteristics of particular components of the environment;
- diagnostic, including assessment of condition and functioning of the environment;
- conclusive, comprising recommendations for spatial development arising from the carried out studies/analyses.

Use of landscape units as basic areas of assessment was a significant assumption made for the methodology of the Municipal study of spatial development conditions and directions for Kielce. Directions on spatial development completed in the conclusive part of the environmental study also applied to landscape units.

The main criteria for distinguishing landscape units were land cover and relief. Supplementary criteria included water conditions, soils and vegetation. When possible, boundaries of units were adjusted to road courses or other spatial elements which are easily recognizable in the townscape. Altogether 309 units were demarcated. Issues regarding protection and shaping of the visual aspects of landscape were included in each part of the environmental study:

- the analytical part presented changes within the city landscape and visual exposure of its particular sections;
- the diagnostic part assessed preservation of landscape values;
- the conclusive part used the identified landscape determinants to specify guidelines for spatial development, primarily for location of built-up areas.

**Study area**

The research comprised the city of Kielce within its administrative boundaries. Kielce, which is the capital of the Świętokrzyskie Province, is the biggest urban centre in the region with a population of 203,804. The area of Kielce covers 109,45 km² [the Regional Data Bank of the Central Statistical Office (GUS) as for 31 December 2010]. Kielce serves as the administrative centre and plays a significant role as the economic, educational and cultural centre of this part of the country.

Kielce is situated in the region of the Lesser Poland in the microregion of the Kielecka Upland in the mesoregion of the Świętokrzyskie Mountains. The city is characterized by diverse landform. Within the city boundaries there are the Posłowieckie and Dymińskie Ranges. Kielce is crossed by a small river – the Silnica, which is the right-bank tributary of the Bobrza River. Differences in the relative height of the city area reach 171 m. The lowest parts of Kielce are located 235 m above sea level (the River Bobrza Valley in the region of Białogon); the highest part is situated 406 m above sea level (Mount Telegraf).

Another important element of the city’s characteristic are remnants of the former exploitation of rock materials. Presently former quarries belong to the attractive elements of the townscape of Kielce. It is worth emphasizing that the economic activity related to sourcing and processing rock materials and lead, copper and barium deposits was run in the area of today’s Kielce as soon as in the 16th century (Guldon, Kaczor, 1994).

Kielce received town privileges in 1364. The most valuable historic monuments include:

- Bishop’s Palace (17th c.), Cathedral (12th – 18th c.), Bernardine Monastery on the Karczówka hill (17th c.-18th c.),
- spatial structure and architecture of Wolności square (the 2nd half of the 19th c.),
- buildings of Sienkiewicza Street from Moniuszki Square to Paderewskiego Street (19th – 20th c.),
- urban layout of the post-industrial buildings in Białogon (the 2nd half of the 19th c.) (Adamczyk 1998).

**Materials and Methods**

To set the determinants of the city’s development, which result from the requirements of protection and formation of landscape physiognomy, the following analyses were performed:

- the analysis of landscape changes
- the analysis of visual exposure
- the assessment of landscape values preservation and landscape changes
It must be noted, that such studies are not common in polish planning practice. In contrast to other countries (eg. Great Britain - Swanwick, 2002) in Poland there are no methodological guidelines to assess values and character landscape (Bożętka, 2008)
Table 1 shows general characteristics of the above mentioned analyses.

Table 1. Survey overview

<table>
<thead>
<tr>
<th>General topic of the survey</th>
<th>Investigated elements</th>
<th>General aim of the survey</th>
<th>Materials</th>
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<tbody>
<tr>
<td>Landscape changes</td>
<td>Extent of the urban fabric Character of built-up areas Origin of built up areas</td>
<td>Specifying directions of town-scape changes</td>
<td>Archival land use maps</td>
</tr>
<tr>
<td>Visual exposure</td>
<td>Range of view from static view points (scenic view points) Range of view from dynamic view points (sequence of view points along roads)</td>
<td>Indicating the most exposed areas of the townscape</td>
<td>Digital terrain model</td>
</tr>
<tr>
<td>Landscape values assessment</td>
<td>Range and character of land use changes</td>
<td>Determining the level of landscape values preservation Determining the impact range of areas with different levels of change on the townscape</td>
<td>Landscape changes Visual exposure</td>
</tr>
</tbody>
</table>

Landscape changes

The purpose of the analysis was to determine directions of landscape changes with special regard to built-up areas which constitute the basic material of the townscape scenery. Despite much longer history of Kielce’s municipal development, by reason of the dynamics of the city’s development in the 2nd half of the 20th century, this very period was encompassed in the research. It is worth emphasizing that in the years 1949 – 2008 the population of Kielce increased from 49 960 to 205 665, that is by 412 %. The city’s area increased almost three times, from 4052 to 10 945 ha. During that period the functional structure of the city was extensively altered, mainly due to the construction of large industrial plants, which resulted in the dynamic growth of housing estates.

The analysis of landscape changes chiefly included the changes which regarded land cover as well as spatial structure of particular elements of development constituting the townscape. Stratigraphy of formation and/or transformation of permanent elements of development such as: built-up areas, communication routes, surface exploitation and green areas, recreation grounds, forests and woodlands, open waters and agricultural areas was defined on the basis of archival cartographic material (topographic maps of Kielce from the years 1929, 1939, 1978, 1980, 1992).

While determining cultural stratigraphy three time periods were considered thus differentiating: areas which came into existence in the 1st half of the 20th c., areas from the 3rd quarter of the 20th c. and those from the 4th quarter of the 20th c. The latest category included areas formed in the 1st decade of the 21st c.

Additionally, changes within the character and directions of transformation for the built-up areas were determined. While specifying the character of the built-up areas their spatial structure, shape and function were taken into consideration. Five types of areas were then distinguished: inner city areas, town areas, town areas formed from suburban areas, suburban areas formed from rural areas as well as those established ‘in cruda radice’.

Visual exposure

The basis for carrying out visual exposure was a digital terrain model of Kielce, which was made by connecting,
in accordance with the map algebra principles, the following raster layers information:
- digital terrain model (maximum height error 0.6 m);
- altitude building model (CityGML LoD 1, maximum height error ca. 1 m, the height of the ridge count);
- simplified vegetation model (height of vegetation: forest: 15 m, shrubbery: 10 m, bushes: 3 m).

Visual exposure maps were generated on the basis of the viewpoints located in the area and applied ArcGIS Spatial Analyst software. The following assumptions were made for the needs of the analysis:
- observer height 1.5 m;
- 360 degree horizontal viewing angle;
- vertical angle +/- 30 degrees

While calculating the area's visual exposure the curvature the earth was taken into account. The analysis of exposure was carried out on the basis of the distinguished viewpoints (31) and the sequence of points located along major transit roads and hiking trails (altogether 74 points distributed along the communication routes every 500 m).

**Landscape values assessment**

The bases for the assessment of landscape values preservation were: the analysis of landscape changes and the analysis of visual exposure.

The assessment of landscape values preservation, according to the applied methodology of the environmental study, was carried out in landscape units.

The major criterion applied for determining the state of landscape values preservation was the extent of land cover changes.

When the land cover was not changed or altered to a small extent (e.g. changing agricultural lands into fallow lands), it was claimed that the landscape values were preserved.

In case of areas whose cover was changed, they were classified within the group of changed (not preserved) landscape values.

With regard to the character of changes (positive, negative and neutral) the following areas were identified:
- the areas whose landscape values were changed positively (landscape units in which new, townscape enriching elements of development occurred);
- the areas whose landscape values were changed neutrally (landscape units which were transformed but the intensity and character of the changes does not disrupt the townscape);
- the areas whose landscape values were changed negatively (landscape units whose landscape values deteriorated, where the scale and structure of the buildings do not correspond to the historically created urban fabric).

With regard to diverse visual exposure of the unbuilt areas whose landscape values deteriorated, they were divided into two groups: the areas of local impact and the exposed areas which influence other town spaces.

**Results**

**Landscape changes**

As a result of the carried out analysis four categories, all of which having different origin of formation and different character of changes within the spatial structure, were distinguished:
- spatial structures created before the 2nd half of the 20th c., complemented and/or distorted. This category included former rural and suburban areas which were expanded through thickening of the built-up as well as adding new built-up lines. The scale and form of their architectural structure was preserved.
- spatial structures created in the 3rd quarter of the 20th c., complemented and/or distorted. The category included former rural or suburban spatial structures which were successively expanded through complementing the built-up and adding new built-up lines. The scale and form of architecture were preserved.
- spatial arrangements created before the 2nd half of the 20th c. whose spatial structure was transformed and
whose scale and form of the built-up contrasted with the historical townscape. This category included mainly town areas in which the architectural substance was replaced leading to changes in the spatial structure of the built-up.

- spatial structure created in the 3rd and the 4th quarter of the 20th c. whose scale and form of the built-up contrasted with the historical townscape and/or open space. This category chiefly included areas founded ‘in cruda radice’.

These are predominantly urban and suburban areas of the Kielce townscape which underwent the most dynamic changes. The inner city areas are well preserved, with clear urban layout and maintained stylistic features of their architecture. At the same time, the site abounds in the highest number of landscape dominants which constitute the historical silhouette of the city.

The town areas which surround the inner city underwent extensive transformation as a result of the exchange of the architectural substance. Multi-family units of a scattered structure and architectural form which did not comply with the historically formed row housing (first of all areas surrounding the old-town buildings) were built there. These areas were included in the spatial structure whose scale and architectural form disrupted the townscape. This category also included the areas of housing estates and manufacturing and service areas established in the so called ‘cruda radice’, which dominate in the northern part of the city and can be found in the western and southern part of Kielce. The areas of manufacturing and service character founded in the so called ‘cruda radice’ are mainly centred along communication routes, both wheel and rail ones.

It should be noted that the dominants which impact the townscape exceptionally aggressively, disrupting the open view from the inner city, predominantly concentrate in the areas founded in the so called ‘cruda radice’ and serve residential and manufacturing and service functions.

The other town sites with dominating single-family dwellings as well as the suburban areas should be considered well-blended into the landscape. The spatial structure of these areas was disruptively transformed by complementing it or adding new built-up lines. The areas whose spatial structure was deformed are mostly suburban areas turned into the urban ones, located in the southern or eastern part of the city. The areas of complemented building complexes are the today’s suburban areas formed from the rural spaces located peripherally, mostly in the north-western, western and southern part of the city.

Landscape changes in the studied period also regarded the open spaces, mainly green areas and sport grounds, open water areas as well as, to a lesser extend, forests and cultivated lands. Newly created green areas and sport grounds were mainly located in the valley of the Silnica River as well as in the vicinity of the multi-family units. Exceptions were vast areas of allotment gardens usually located on the outskirts of the city.

In the analysed period a few water reservoirs were created. The most important ones are the Kielecki Reservoir and the Mójcza Reservoir which serve recreational purposes. The other ones are fish ponds located mainly in the northern part of the city and water reservoirs created in the post-exploitation areas.

The spatial structure of the forests was considered relatively stable. Newly observed afforestations are mainly connected with widening the borders of existing forests. The exception here is a forest patch located on the west side of the city, on both sides of the railway track, and spontaneous afforestation of the Silnica valley.

Despite intensive changes in the functional and spatial structure resulting from the expansion of development, cultivated lands can still be found within the city limits. However, it needs to be emphasized that only the peripherally located areas managed to preserve their agricultural character. The remaining ones were transformed into wastelands of functional character.

Visual exposure

The results of the visual exposure analysis were shown as the classification of areas, depending on their visibility from the previously assigned scenic viewpoints.

5 classes of exposure were distinguished: very high (areas visible from more than 17 viewpoints), high (areas visible from 9 to 16 viewpoints), big (areas visible from 5 to 8 viewpoints), medium (areas visible from 2 to 4 viewpoints), low (areas visible from 1 viewpoint or invisible from any of them).

The results of the visual exposure analysis carried out for the areas of high cultural value (old-town and
monastery on the Karczówka hill) was verified during fieldwork. The analysis of the city’s visual exposure allowed for presenting areas which were highly exposed in the townscape. Among the areas which were identified as having exceptionally high visual exposure, the below listed ones were considered particularly important:

- the areas important for maintaining the visual exposition of the sites which represent high cultural values (including areas located at the foot of the Karczówka hill)
- the unbuilt areas with low vegetation (having in consequence low ability to adopt changes) being the potential grounds for the city’s growth (including the areas mainly situated in the eastern and north-eastern part of the city).

**Landscape values assessment**

As a result of the carried out analysis five classes of landscape units were differentiated, depending on the level of changes within the land cover and landscape visual exposition. (table 2).

<table>
<thead>
<tr>
<th>Value assessment</th>
<th>Qualities of landscape units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preserved values</td>
<td>The areas of preserved cover and development, mainly forests and cultivated lands as well as areas of minor cover transformation and low intensity of the character of changes connected with, for example, the increased amount of afforestation and field bushes as a result of ceasing to cultivate land, lying fields fallow and set-aside, complementing the built-up while maintaining spatial structure as well as form and dimensions of the buildings.</td>
</tr>
<tr>
<td>Preserved values of exposed areas with low vegetation</td>
<td>The areas covered with low permanent vegetation exposed in the landscape from the highest number of viewpoints as well as those exposed from the viewpoints significant for perception of the townscape (the old town, the Karczówka hill, tourist routes, recreation areas).</td>
</tr>
<tr>
<td>Positively transformed values</td>
<td>The areas of water reservoirs and recreation areas</td>
</tr>
<tr>
<td>Neutrally transformed values</td>
<td>The areas of suburban and town built-up whose scale and form does not distort the townscape, the areas of social infrastructure, afforestations, wastelands neighbouring the built-up areas which lost the features of agricultural landscape.</td>
</tr>
<tr>
<td>Negatively transformed values</td>
<td>The areas of housing estates, mainly multi-family dwellings, manufacturing and service areas of a scale and form contrasting with the historically formed townscape and/or open spaces.</td>
</tr>
<tr>
<td>Negatively transformed values which are exposed in the landscape</td>
<td>The areas of housing estates, mainly multi-family dwellings, manufacturing and service areas of a scale and form contrasting with the historically formed townscape and/or open spaces exposed in the landscape from the highest number of viewpoints as well as from the viewpoints significant for perception of the townscape (the old town, the Karczówka hill, tourist routes, recreation areas).</td>
</tr>
</tbody>
</table>

On the basis of the carried out assessment it was concluded that the areas of preserved values dominate in the southern and western part of the town. These are mostly the areas of vast forests covering the Dymińskie and the Posłowieckie Ranges as well as the areas of river valleys. The sites of preserved landscape values are also the most valuable from the cultural perspective, and include the old town, the Karczówka monastery hill and the urban layout of Białogon. The areas of positively transformed values are predominantly town parks as well as the grounds of the Kielecki and the Mójczka Reservoirs. The areas of negatively transformed values dominate in the northern part of the city and these are mostly housing estates - mainly multi-family dwelling and manufacturing and service areas whose scale and form contrast with the historically formed townscape and/or open spaces.
Conclusions

The determinants and restrictions of spatial development resulting from the analysis of the landscape changes mainly regard:
- the areas with preserved landscape values
- the areas with negatively transformed landscape values
- the unbuilt areas which are exposed in the townscape.

Generally, for the built-up areas of preserved landscape values the principle of restricted implementation of investments should be followed, since they can negatively impact their perception and distort the historical silhouette of the city.

For the reasons of permanency of transformations it is difficult to determine the direction of changes for the areas whose landscape values are altered negatively. However, their landscape exposition can be avoided through, for example, vegetation screening or avoiding aggressive elevation colours or.

In case of the still uninvested areas, which are exposed the most in the landscape, one should aim at utmost preservation of their landscape values. In case of scheduled transformations of these areas connected with implementation of the built-up, aggressive elements whose scale, form and colour could interfere with the landscape values should be avoided. Most favourably, within these areas single-unit housings of low density and high level of biologically active areas should be located.

The results of the carried out analyses of landscape changes along with the visual exposure analysis were used for the final environmental determinants.

From among the areas recommended for sustaining current use and limited development, for which a total of 6 categories of area were differentiated, one of them resulted from the landscape determinants. Similarly, from among the areas recommended for the development of town functions (8 categories in total) one category resulted directly from the above determinants. The environmental determinants resulting from landscape visual conditions are presented in table 3.

Table 3. Environmental determinants resulting from landscape conditions

<table>
<thead>
<tr>
<th>Type of area</th>
<th>Recommendations for spatial development</th>
</tr>
</thead>
<tbody>
<tr>
<td>AREAS RECOMMENDED FOR MAINTENANCE OF PRESENT DEVELOPMENT AND</td>
<td></td>
</tr>
<tr>
<td>RESTRICTED EXPANSION OF DEVELOPMENT</td>
<td></td>
</tr>
<tr>
<td>Areas significant for preservation of the landscape exposition of objects</td>
<td>- Preservation of the present land cover,</td>
</tr>
<tr>
<td>representing particular cultural values</td>
<td>- Not increasing the percentage of high vegetation,</td>
</tr>
<tr>
<td></td>
<td>- Restrictions in locating high construction works which could interfere with the exposition of the</td>
</tr>
<tr>
<td></td>
<td>Karczówka hill,</td>
</tr>
<tr>
<td>AREAS RECOMMENDED FOR THE DEVELOPMENT OF TOWN FUNCTIONS</td>
<td></td>
</tr>
<tr>
<td>Areas exposed in the townscape</td>
<td>- Due to the low ability to adopt changes restrictions on locating objects whose scale and form are</td>
</tr>
<tr>
<td></td>
<td>not adjusted to the surrounding landscape</td>
</tr>
</tbody>
</table>

The specified environmental determinants resulting from the analysis of the landscape changes, visual exposure and changes within the landscape values preservation, after being entered into the records of the study, can become a significant tool for protection of the landscape visual values. On the one hand they can help to preserve the most precious parts of the townscape, and on the other hand enable to avoid its negative transformations.
References


Rozporządzenie Ministra Środowiska. z dnia 9 września 2002 r. w sprawie opracowań ekofizjograficznych, Dz. U. Nr 155, poz. 1298 (Regulation of the Ministry of the Environment of 9 September 2002 on the environmental studies, Journal of Laws No 155, item 1298).


Guldon Z., Kaczor J., 1994: Górnictwo i hutnictwo w Staropolskim Okręgu Przemysłowym w drugiej połowie XVIII wieku (Mining and metallurgy in the Old Polish Industrial Region in the second half of the eighteenth century). Towarzystwo Przyjaciół Górnictwa, Hutnictwa i Przemysłu Staropolskiego, Kielce.